Late Quaternary slip rate for the Chino fault, southeastern Los Angeles basin, California

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Introduction

Until recently the Chino fault in southern California lacked clear paleoseismic evidence of Holocene activity and its late Quaternary sense of slip and slip rate remained enigmatic. Treiman (2002) and Walls and Gath (2001) illustrated that the tectonic geomorphology of the Chino fault indicates predominantly right-lateral strike-slip motion, based on northeast-facing fault scarps, saddles, offset ridgelines, deflected drainages, and beheaded drainages in the Chino Hills. The Chino fault was zoned as active by the State of California based on a trench logged by C. Walls and E. Gath of ECI that revealed evidence for at least two earthquakes in the last 14,200 years and a late Quaternary oblique slip rate of 0.36-0.51 mm/yr (Walls and Gath, 2001). This rate may be too low for the fault overall: a long-term slip rate south of the trench site based on evidence for 700-1350 m of right-lateral offset of the Miocene Soquel sandstone and on the vertical separation of the Miocene Yorba-Sycamore Canyon contact is 0.7-2.2 mm/yr. We hope to refine the Late Quaternary slip rate for the Chino fault with a 3-D paleoseismic study near the area of maximum long-term offset. Combined with existing data, this will allow us to evaluate whether slip on the Chino fault changes along strike and provide further constraints for evaluating the seismic hazard of the fault.

Preliminary Results

Last summer we opened six trenches in and around a small offset drainage at the front of the southern Chino Hills to locate active strands of the Chino fault (Figure 1). The drainage is incised into older alluvial fan deposits along the range front that are faulted against Miocene bedrock of the Chino Hills. Four trenches were placed in the drainage along the inferred down-dip projections of scarps, saddles, and benches identified on fan surfaces adjacent to the drainage (Figure 2). Two trenches were placed at the interface between the Chino Hills and the fan surface.

Excavations within the drainage revealed a wide zone of northwest-striking high-angle faults coincident with scarps and saddles at the drainage margins. Faults within this zone cut bedrock of the Miocene age Puente Formation but do not deform overlying colluvium, channel, or debris flow deposits (Figure 3). Based on the degree of soil development in these overlying deposits, we infer that the bedrock faults have not ruptured since at least the Late Pleistocene. The lack of uphill-facing scarps on the exposed northern margin of the drainage, as would be formed by right-lateral offset of the stream channel, further suggests these faults are inactive. Radiocarbon dates from deposits overlying the fault zone are pending.

Trenches across a subtle break in slope on the fan surface to the west and upslope of the inferred inactive strands of the Chino fault revealed a 10-m-wide low-angle reverse fault zone that dips 0 to 30 degrees to the southwest, with fault splays in the hanging wall dip up to 60 degrees (Figure 4). This zone juxtaposes bedrock over older alluvial fan deposits, suggesting the fault has experienced Quaternary movement. Unfortunately, with such a low dip angle, projecting the fault into the drainage where we intended to conduct our 3-D investigation places it up-canyon from any active deposition. The lack of sediments with which to record events precludes a precise determination of activity for the low angle fault and precludes determination of its slip rate.

Based minimal deflections of older stream channels and fans along strike of the low- angle fault coupled with the lack of recent activity on the higher angle faults in the drainage, we infer the southern Chino fault has been relatively inactive during Holocene. This raises the question of whether Chino fault is still active in the south, and what drives activity on the northern portion of the fault. In the coming months we will try to answer these questions with additional geomorphic analysis along the fault.

Non-technical Summary

Slip rate is a vital component for determining the seismic hazard of a fault. For this investigation we attempted to constrain the Holocene slip rate for the Chino fault where it exhibits maximum offset. Instead, we found that the southern portion of the fault may not be active.

Reports Published

None

References

Treiman, J.A., 2002, Chino fault, Riverside and San Bernardino counties, California: California Geological Survey Fault Evaluation Report FER-247, 17 p., 3 pl..

Walls, C., and Gath, E.M., 2001, Tectonic geomorphology and Holocene surface rupture on the Chino fault: Southern California Earthquake Center Annual Meeting, proceedings and Abstracts, p. 118.

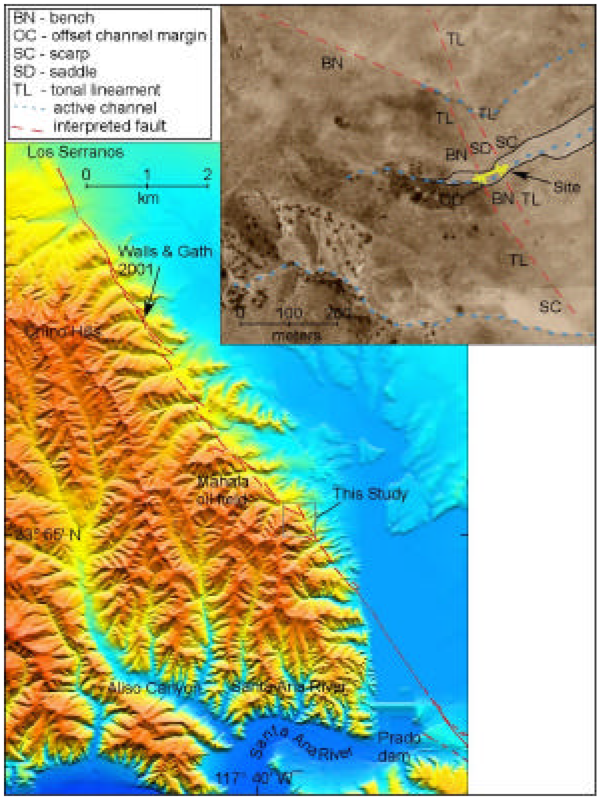

Figure 1. Shaded relief map of the Chino fault bounding the east side of the Chino Hills. The study site of Walls and Gath (2001) is located approximately 3 km southeast of the fault tip in Los Serranos. Our study area is located ~5 km southeast along the fault. The inset aerial photograph shows the tectonic geomorphic features that delineate the fault on both sides of the ~40 meter wide drainage at our study site.

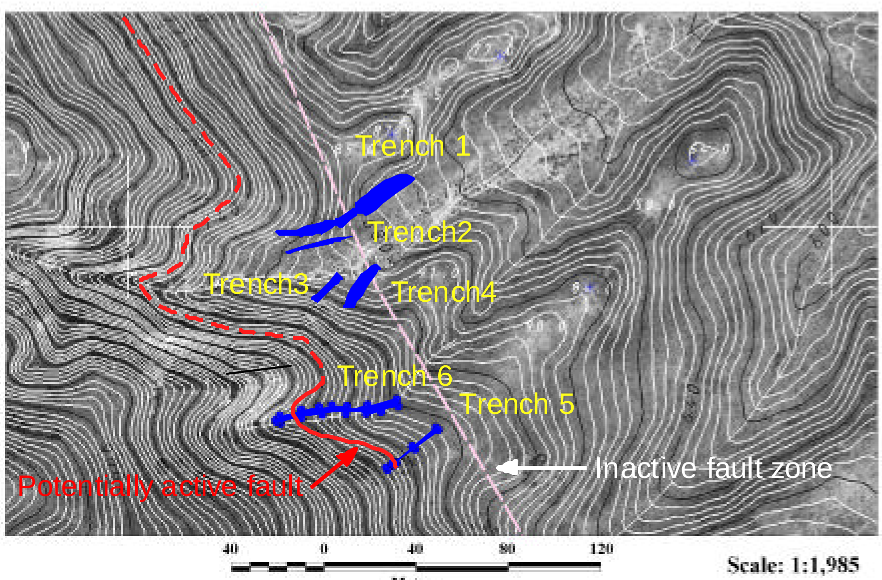

Figure 2. Topographic site map on photo base showing trench locations (blue), inferred inactive high angle fault zone (pink), and potentially active low angle fault zone (red).

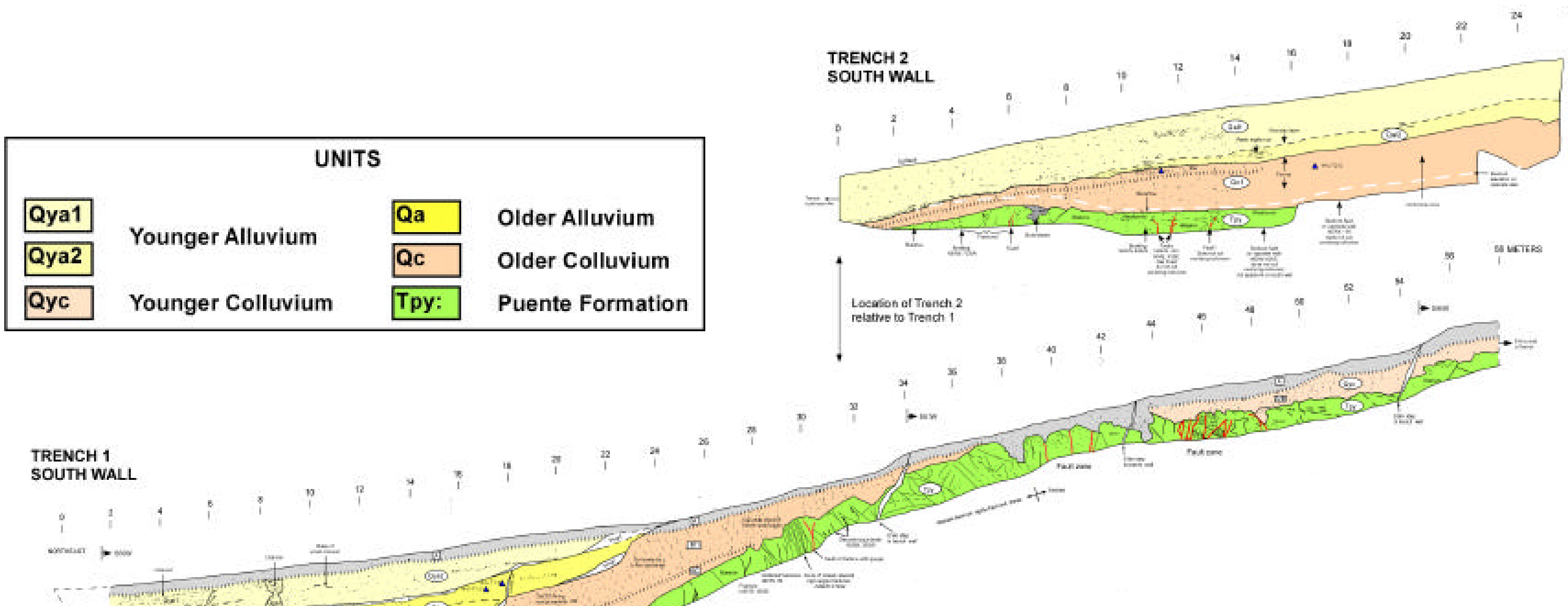

Figure 3: Logs of trenches 1 and 2 (see Figure 2 for location). Faults in trenches 1 and 2 do not appear to show recent activity. If they had ruptured recently they would cut older colluvium (Qc), which has a moderately developed argillic soil, and offset northern bedrock channel wall, creating an uphill facing scarp.

PORTION OF TRENCH 5
NORTH WALL

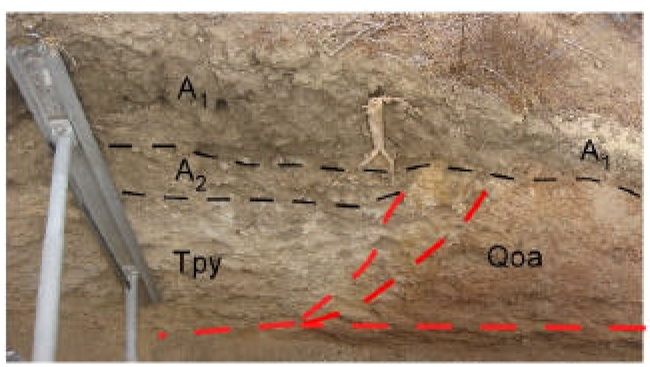

Figure 4. Trenches on the fan surface above the channel exposed a series of horizontal faults with sub-vertical splays. This fault zone juxtapose Miocene bedrock (Tpy) against older alluvium (Qoa) suggesting Quaternary movement. Although the extreme low angle of the basal fault suggests that this structure is actually a landslide, there is no geomorphic evidence upslope to support this conclusion.